

August 16, 2001

Mr. Kevin F. Borton, Manager, Licensing
Exelon Generation
300 Exelon Way
KSB3-S
Kennett Square, PA 19348

Dear Mr. Borton:

The purpose of this letter is to provide you with NRC staff comments on your proposed licensing approach for the Pebble Bed Modular Reactor (PBMR) regarding your licensing approach. The staff's comments are included in Enclosure 1 to this letter. The staff will be issuing a Commission paper in November 2001 to inform the Commission of the staff's assessment of your proposed licensing approach. To support the Commission paper, the staff has previously requested that you submit a revised version of your licensing approach by August 31, 2001, to be used as the basis for the staff's assessment. To the extent practical, the revised licensing approach should address the enclosed comments.

If you or your staff have any questions or require additional information please do not hesitate to contact either me (301-415-5790) or Stuart Rubin (301-415-7480).

Sincerely,

/RA/

Thomas L. King, Director
Division of Risk Analysis & Applications
Office of Nuclear Regulatory Research

Enclosure: As stated

Project No. 713

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NRC Staff Comments on Proposed Licensing Approach

The staff's comments on the licensing approach documents provided to date by Exelon are provided below. The staff has also compiled a list of implementation issues which would need to be resolved prior to, or as part of, the licensing review for the pebble bed modular reactor. This list is also included below.

Comments on licensing approach:

1. Exelon has indicated that the NRC staff's review of the proposed licensing approach should focus on the acceptability of the approach and not the acceptability of the PBMR design. The NRC staff agrees that this should be the focus of its review at this stage of the pre-application process. It would also be the focus of the Commission paper to be issued in November 2001. However, the licensing approach documents reviewed to date include a number of unsubstantiated statements or assumptions about the pebble bed modular reactor (PBMR) design. The staff has requested that a revised licensing approach be submitted to the NRC by August 31, 2001. The staff's review of the licensing approach will not assess the acceptability of statements relative to the design of the PBMR.
2. Completeness and modeling uncertainty in accident potential and subsequent analysis is generally handled by including defense-in-depth (DID) and safety margins in the plant design and operation. The Exelon documents reviewed suggest that the DID principles in Reg Guide 1.174 will be considered and that the PRA will include an assessment of the contributors to uncertainty resulting in a quantitative assessment of the safety margin. Detailed information on how this will be accomplished will be necessary for the staff to make a final determination of the acceptability of Exelon's licensing approach.
3. Exelon has proposed a licensing approach which identifies Top Level Regulatory Criteria (TLRC) and which are depicted on a diagram of the mean frequency per plant year vs. dose at the exclusion area boundary. This figure shows schematically how Exelon proposes to use risk criteria for the PBMR as a basis to determine anticipated operational occurrences (AOOs), design basis events (DBEs), and emergency planning basis events (EPBEs), which are collectively called Licensing Basis Events (LBEs). The use of this approach in a supplemental role to deterministic methods and existing risk metrics is encouraged subject to verification of the assumption that the frequency ranges are validated by analysis and testing. This approach could be expanded to worker protection (e.g., 10 CFR Part 20 has occupational dose criteria for normal operation and 10 CFR Part 50, Appendix A, Criterion 19 has a dose criteria for personnel in the control room during DBEs). Risk assessments of DOE non-reactor nuclear facilities have used both public and worker dose criteria as risk criteria.
4. With regard to the TLRC criteria themselves, several issues need to be addressed. First, the current regulations include a frequency reference for the definition of AOOs but a similar reference does not exist for DBEs. Exelon's selection of 1E-4/yr as the lower frequency for a DBE is not consistent with (A) current licensing practice; (B) the RIP50 (Risk Informing of 10 CFR Part 50) Option 3 framework guidelines provided in SECY-00-0086; (C) the frequencies of accident that are to be compared to the dose criteria contained in 10 CFR Part 100 and 10 CFR 50.34; and (D) the frequencies used in evaluating other advanced reactors.

5. 10 CFR Part 100 and 10 CFR 50.34 criteria of 25 rem TEDE assume that the containment is intact, i.e., the dose occurs due to leakage from the containment. Exelon should explain the assumptions being used in the TLRC.
6. In addition to the TLRC, Exelon should consider the use of deterministic licensing criteria, such as a peak pebble temperature, degraded pebble geometric configurations, or flow bypass caused by unexpected flow channelization for selection of structures, systems, and components (SSCs) to mitigate LBEs.
7. The Exelon documents reviewed compare the calculated dose from individual DBEs, AOOs, and EPBEs to the TLRC by depicting the calculated doses and the TLRC on a diagram of the mean frequency per plant year vs. dose at the exclusion area boundary. We are unclear on what is actually being compared. It is possible to interpret the AOO and DBE portions as graphical representations of the criteria used in the licensing of existing reactors. Specifically, the listed criteria are essentially the same as those used in current Final Safety Analysis Report Chapter 15 analyses. In this interpretation, the AOO and DBE frequencies used in the comparison to the criteria would be the frequencies for mitigated accidents, since this is what is currently done. In this interpretation, deterministic criteria must also be established for determining the adequacy of the SSCs for mitigating the transients and accidents chosen from the PRA to be LBEs.
8. The licensing approach should be used to show that the cumulative risk from all accidents of a particular frequency is less than the value of the TLRC at that particular frequency. In this usage, the y-axis on the TLRC should be the frequency of exceedance of a calculated dose. A hundred accidents each with a low frequency may result in an acceptable dose but when summed, the total frequency for those accidents can lead to unacceptable risk. In addition, the cumulative risk from all accidents should be less than that stated in the NRC Safety Goal Policy Statement.
9. The NRC Advanced Reactor Policy Statement expects that advanced reactors will provide enhanced safety margins compared to current generation light-water reactors. Exelon should explain how the use of the top level regulatory criteria will achieve enhanced safety margins consistent with the NRC policy statement.
10. Exelon's licensing approach will use risk assessment to identify licensing basis events (LBEs), the safety functions needed to mitigate these events, and the SSCs that need to be given special treatment. Exelon should explain how non-safety SSCs will be treated in the risk assessment.
11. Exelon has indicated that core damage frequency (CDF), large early release frequency (LERF), and containment performance may not be appropriate risk measures for the PBMR due to its inherent and passive safety features. Exelon should address questions such as what alternative metrics are proposed and how important concerns will not be precluded through the third selection criteria for the TLRC, i.e., that the TLRC should be well defined and quantifiable.

Implementation Issues:

1. In order to better plan and budget NRC activities, Exelon should provide a schedule of when the licensing approach will be implemented including milestones such as identification of LBEs, identification of SSCs, etc.
2. Exelon's licensing approach includes a process for screening existing NRC regulations for applicability to the PBMR and acknowledges the possibility that new PBMR-specific requirements and new PBMR-specific guidance could be required. In order to determine the applicability of existing regulations to the PBMR and to determine the need for new requirements or guidance, PBMR design and probabilistic risk assessment (PRA) information is required. In their absence, the applicability evaluations appear to be based on assumption of design characteristics which have not been clearly documented. Therefore, while it is recognized that a final decision by the staff on the need for new requirements and guidance will not be possible until detailed PBMR design and PRA information is available, for pre-licensing reviews articulation and documentation of design assumptions will be required.
3. The staff and Exelon should have a common understanding of terms to facilitate effective pre-application and licensing reviews. The Exelon documents reviewed use several terms that the staff will need to better understand such as "poor performance of the fuel," "effects of poor performance of the fuel on plant risk," "failure of significant number of fuel particle coatings" and "accident conditions that can lead to failure of the coatings or fuel particles."
4. The Exelon documents reviewed state that the TLRC should be a necessary and sufficient set of direct statements of acceptable health and safety as measured by the risks of radiological consequences to individuals and the environment. A footnote to this statement states that the term risk as used here implies the definition of a reasonably complete set of event sequences or scenarios, estimates of their frequencies and consequences, and a thorough understanding and quantification of uncertainties in these frequency and consequence estimates. Exelon should define what is meant by a reasonably complete set of event sequences or scenarios, including what criteria would be used to exclude event sequences or scenarios from the PRA, and how the adequacy of the PRA will be assured with the exclusion of these sequences and scenarios.
5. The Exelon documents reviewed state that the PRA to be used in the licensing process will meet acceptable standards. A clear explanation is needed as to what this statement means.
6. The licensing approach does not address how safeguards and sabotage will be addressed, i.e., will there be a safeguards PRA or will traditional approaches be used.

cc:

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